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(54) LEVELLING OR STABILIZING LEG SYSTEM

(71) I, KENNETH JOSEPH DAINTY, a British subject, of 38 Henderson Road, Forest Gate, London E.7, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention is concerned with a levelling or stabilizing leg system.

I have developed a system of two or more legs for supporting a load on an uneven surface wherein the legs automatically compensate for the unevenness of the surface as the load is lowered onto it. According to my system, as each leg contacts the surface on lowering the load onto the surface, the leg telescopes inwardly relative to the body until the last leg contacts the surface, whereupon the legs are prevented from further inward telescoping and support the load.

According to the present invention, therefore I provide a levelling or stabilizing hydraulic leg system for supporting a load on an uneven base surface, which comprises two or more legs each connected to a piston of a respective hydraulic piston/cylinder combination, means for coupling the cylinders together to allow flow of hydraulic fluid therebetween, an outlet in each cylinder for hydraulic fluid and means for closing the fluid outlet in each cylinder in response to relative movement of the respective piston and cylinder as the respective leg contacts the surface and retracts into the cylinder during lowering of the load onto the surface in use.

Until the outlet is closed, relative movement between the piston and cylinder causes hydraulic fluid to be expelled from the cylinder. In order to preserve this fluid and to allow it to be reintroduced into the cylinder when the leg system is lifted off the ground and the legs return to the fully extended position, each outlet preferably communicates with a reservoir. Each outlet may have an associated reservoir or, alternatively, a single reservoir may be provided in communication with all or some of the outlets.

Once the last outlet has been closed, the length of the legs can not be altered and it is therefore preferred to provide each cylinder with means for bleeding hydraulic fluid therefrom so that the length of the legs may be adjusted.

While the system described above works satisfactorily when the load on the legs is evenly distributed, an uneven load causes the leg system to tilt because, as a result of different pressures in the cylinders, the hydraulic fluid is forced through the coupling lines from cylinders at higher pressure to cylinders at lower pressure. Accordingly, in a preferred embodiment of the invention, closure means are provided to prevent passage of hydraulic fluid through the coupling lines and these closure means are closed when the leg system has settled on the ground and all the outlets are closed.

In its simplest form, the closure means is one or more manually operated valves operated either directly or by remote control. Preferably, however, an automatic system is provided to close the valve(s) after all the fluid outlets from the cylinders are closed but before the full weight of the load is carried by the legs.

One such automatic system comprises an auxiliary suspension system for the load carried by the legs. The suspension system is adapted to compress under the weight of the load only after all the fluid outlets from the cylinders have been closed and is coupled to the valve so that compression of the system causes the valve to close.

In order that the invention may be more fully understood, preferred embodiments thereof will now be described, by way of illustration only, with reference to the accompanying drawings, in which:—

Figure 1 illustrates diagrammatically an embodiment of the leg system during lowering onto a surface;

Figure 2 illustrates the system of Figure 1 in its final position on the surface;

Figure 3 shows diagrammatically a second embodiment of the leg system with fluid out-

lets closed and valves in the connecting line open; and

Figure 4 shows the system of Figure 3 in its final position with the valves closed.

The system shown in Fig. 1 is a simple two-legged system comprising two hydraulic cylinders 1 and 1′ each having a piston 2 and 2′ to which are connected legs 3 and 3′. The cylinders are connected by conduit 4 which allows hydraulic fluid 5 to flow from one cylinder to the other. Each cylinder 1, 1′ has an outlet 6, 6′ leading to a reservoir 7, 7′ open to the atmosphere by virtue of opening 8, 8′. An annular stop 9, 9′ limits the downward movement of each piston 2, 2′.

In each cylinder 1, 1′, a spring 10, 10′ extends upwardly from piston 2, 2′ and carries at its uppermost end a closure member 11, 11′ adapted to close outlets 6, 6′ in a fluid tight manner. The spring 10, 10′ is of such a length in its extended configuration that, when piston 2, 2′ is resting on stop 9, 9′, closure member 11, 11′ is located a short distance from outlet 6, 6′.

In operation, the leg system with both pistons 2 and 2′ resting on stops 9 and 9′ is lowered towards uneven surface 12. As shown, the first leg to contact the surface 12 is leg 3′ and as the lowering of the system continues, leg 3′ telescopes into cylinder 1′ and pushes piston 2′ upwardly. Some hydraulic fluid 5 is displaced by the piston and flows into reservoir 7′ and/or through conduit 4 into cylinder 1 and thence into reservoir 7.

After a short upward displacement of piston 2′, closure member 11′ bears against the top of cylinder 1′ and closes outlet 6′. During further downward movement of the leg system but before leg 3 makes contact with surface 12, piston 2′ is further upwardly displaced relative to cylinder 1′ and hydraulic fluid displaced by piston 2′ flows through conduit 4 into cylinder 1 and then into reservoir 7. At the same time spring 10′ is compressed, which improves the sealing of outlet 6′ by closure member 11′. The system at this stage is as shown in Figure 1.

When leg 3 contacts surface 12, a small further downward movement of the leg system causes upward displacement of piston 2 relative to cylinder 1 and this upward displacement causes closure member 11 to bear against the top of cylinder 1 and seal outlet 6, as shown in Figure 2. When outlet 6 is closed, the hydraulic system comprising the two cylinders 1 and 1′ and the conduit 4 is sealed and further relative upward movement of the pistons 2 and 2′ is prevented by hydraulic pressure. The legs are therefore locked in this position and can support any body carried by the leg system.

On lifting the system up to move it elsewhere, the weight of legs 3 and 3′ displaces pistons 2 and 2′ downwardly relative to cylinders 1 and 1′ and springs 10 and 10′ pull the closure members 11 and 11′ away from outlets 6 and 6′ allowing hydraulic fluid from reservoirs 7 and 7′ to flow back into the cylinders. The pistons drop down to rest on stops 9 and 9′ and the system is ready to be placed elsewhere.

The leg system shown in Figures 3 and 4 is basically the same as that described in detail above and details of the legs and the basic operation of the system will not be repeated.

In addition, however, the system shown in Figures 3 and 4 includes two turn valves 14 and 14′ located in connecting line 4. Line 4 may be rigid or flexible and, in the latter case, valves 14 and 14′ are rigidly secured to cylinders 1 and 1′.

Associated with each valve is an auxiliary suspension system comprising telescopic tubes 15, 16 and 15′, 16′ and small springs 17, 17′. The suspension system is rigidly mounted on each cylinder 1 and 1′ and supports, for example, a load platform 19. Each tube 16 and 16′ is connected to the respective turn valve 14 and 14′ by a system of pivoted rods 20 and 20′, the rods being pivoted at points 21, 22 and 21′, 22′ and rigidly fixed to the turn valves at points 23 and 23′. Annular stops 24 and 24′ are fixed to tubes 15, 15′ to limit the upward movement of tubes 16 and 16′ and annular stops 18 and 18′ are provided to limit the downward movement of tubes 16 and 16′.

As shown in Figure 3, the whole system is suspended as from a crane by cables 25 and, in the position shown in the figure, lowering of the system to the ground has reached the point at which both fluid outlets 6 and 6′ are closed.

Springs 17 and 17′ are selected to have a stiffness greater than the sum of (a) the force exerted by back pressure in the hydraulic system as the leg system is lowered to the point where the fluid outlets 6, 6′ are closed and (b) the upward force exerted by the larger springs 10 and 10′ during compression. On the other hand, the stiffness factor of the springs 17, 17′ is such that they will compress under the weight of the load platform 19 (or other load supported by the leg system).

In operation therefore, the system is lowered to the ground and the legs telescope to shut fluid outlets 6 and 6′ as described above. During this operation, however, no appreciable telescoping of the suspension systems takes place. Thereafter, further lowering of load platform 19 causes compression of springs 17 and 17′ until tubes 16 and 16′ meet stops 18 and 18′. The downward movement of cylinders 16 and 16′ causes the rod systems 20 and 20′ to close valves 14 and 14′ as shown in Figure 4. The hydraulic system is then locked and no movement of fluid is possible between cylinders 1 and 1′ through line 4.

It will be apparent that the systems described above are simple embodiments of the invention and many more sophisticated modifications will be obvious to those skilled in the art. For simplicity, the invention has been specifically described with reference to two legs but the system may include any number of legs and clearly at least three legs are required to render the leg system self-supporting.

WHAT I CLAIM IS:—

1. A levelling or stabilizing hydraulic leg system for supporting a load on an uneven base surface, which comprises two or more legs each connected to a piston of a respective hydraulic piston/cylinder combination, means for coupling the cylinders together to allow flow of hydraulic fluid therebetween, an outlet in each cylinder for hydraulic fluid and means for closing the fluid outlet in each cylinder in response to relative movement of the respective piston and cylinder as the respective leg contacts the surface and retracts into the cylinder during lowering of the load onto the surface in use.

2. A leg system according to claim 1, in which each outlet communicates with a reservoir to receive hydraulic fluid expelled from the cylinder before closure of the outlet.

3. A leg system according to claim 2, which includes a single reservoir in communication with all the outlets.

4. A leg system according to any of claims 1 to 3, in which the closing means comprises an outlet closure member and spring means extending from the respective piston and adapted to urge the closure member into the closing position in response to movement of the respective leg from its fully extended position.

5. A leg system according to any of claims 1 to 4, in which each cylinder includes means for bleeding hydraulic fluid therefrom.

6. A leg system according to any of claims 1 to 5, in which the coupling means includes closure means to prevent passage of hydraulic fluid through the coupling means.

7. A leg system according to claim 6, in which the closure means comprises one or more manually operated valves operated either directly or by remote control.

8. A leg system according to claim 6, in which the closure means comprises a valve and which includes means for automatically closing the valve during lowering of the load onto the surface in use when all the fluid outlets in the cylinders have been closed.

9. A leg system according to claim 8 in which the valve closing means comprises an auxiliary suspension system for the load carried by the legs, the suspension system being adapted to compress under the weight of the load only after all the fluid outlets from the cylinders have been closed and the suspension system being coupled to the valve so that compression of the system causes the valve to close.

10. A levelling or stabilizing hydraulic leg system substantially as herein described with reference to Figures 1 and 2 of the accompanying drawings.

11. A levelling or stabilizing hydraulic leg system substantially as herein described with reference to Figures 3 and 4 of the accompanying drawings.

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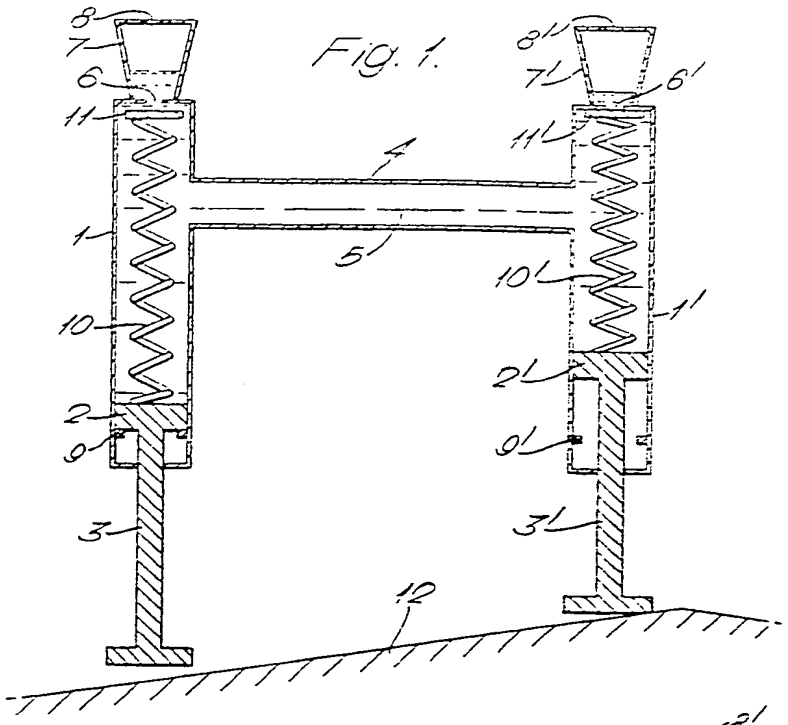

Fig. 1.

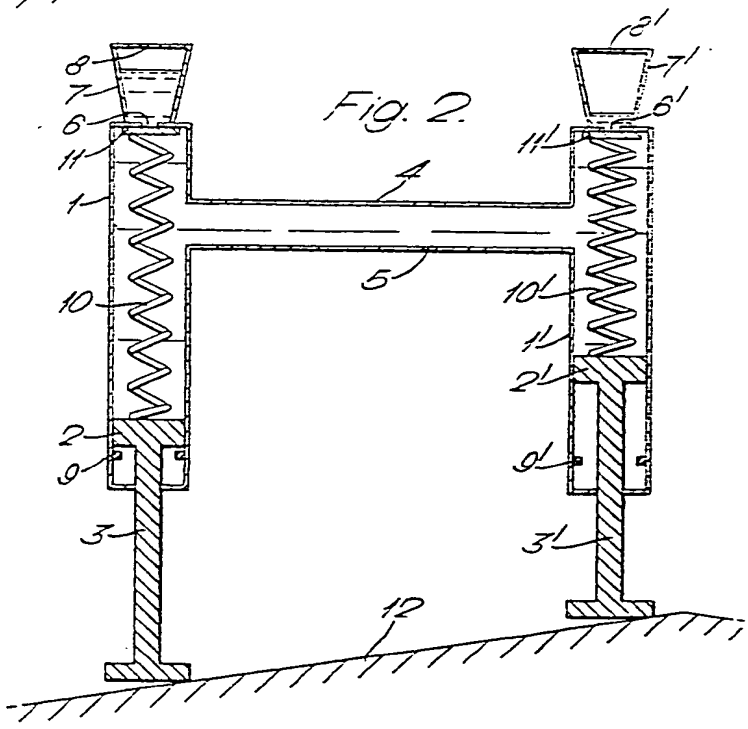

Fig. 2.

1315833 COMPLETE SPECIFICATION
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Sheet 2

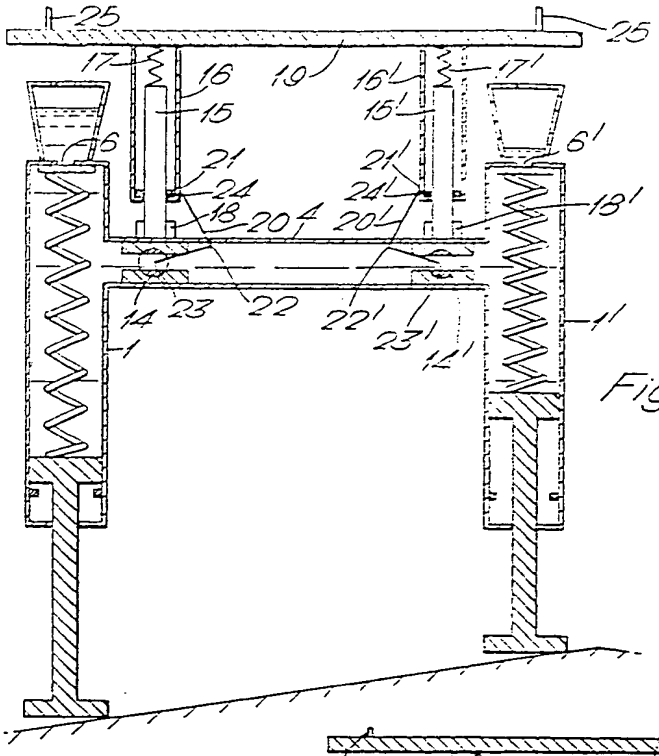

Fig. 3.

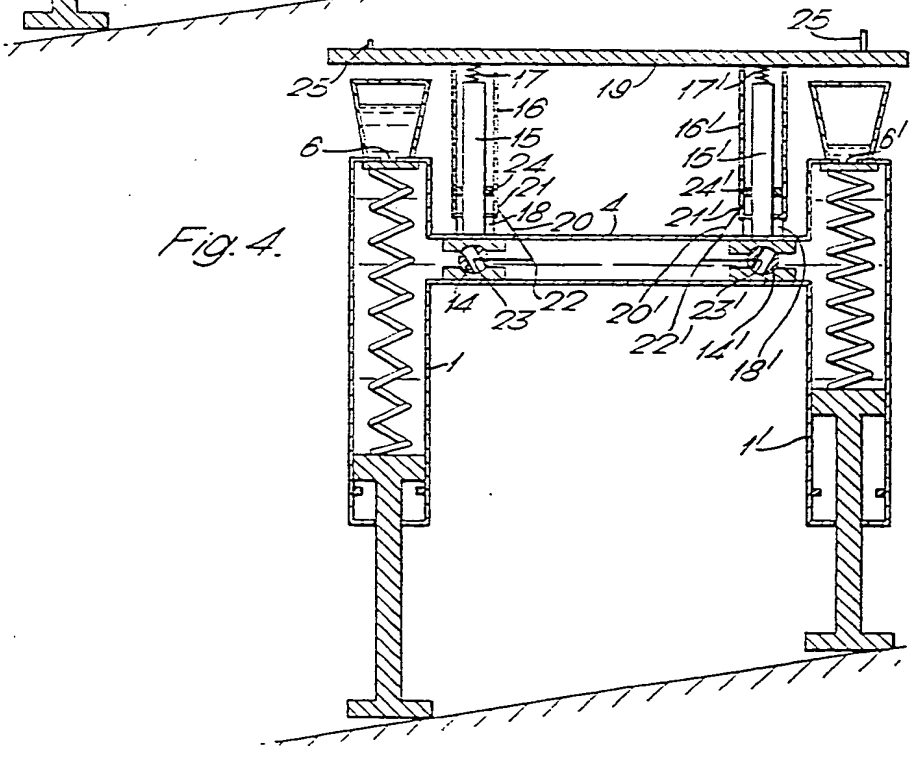

Fig. 4.